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Outcome Measures Following Tele-rehabilitation and Conventional Face to Face Rehabilitation in Paediatric Cochlear Implant Users during COVID-19 Pandemic: A Pilot Study in a Tertiary Care Setup

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Outcome Measures following Tele-rehabilitation and Conventional face to face rehabilitation in paediatric cochlear implant users during COVID-19 Pandemic: A Pilot Study in a tertiary care setup

Abstract:

Background: Following the COVID-19 pandemic, majority of paediatric cochlear implantees (CI) lost follow ups for rehabilitation and tele-therapy was initiated. Present study thus compared the outcome measures of paediatric CI users on tele-therapy versus conventional face to face therapy following COVID-19 pandemic.

Method:

Twenty seven unilateral paediatric cochlear implantees in the age range of 2-11 years were divided into two groups based on the therapy modality, viz, tele- and face-to-face therapy. Based on the hearing age, participants were further divided into three groups, viz, 0-2, 2-4, and greater than four years. A complete test battery comprising Integrated Scales of Development, Speech Intelligibility Rating scale, and Revised Categorical Auditory Perception were administered. The speech & language test battery was performed prior to initiating the rehabilitation and post 12 months of rehabilitation.

Results:

Results of the present study revealed that conventional rehabilitation had better outcomes compared to teletherapy. The rate of progress after one year of rehabilitation with respect to hearing-age showed a significant difference for the hearing-age group of 0-2 years across the domains of audition, speech and language.

Conclusion:

The present study indicates that conventional method of the speech-language and auditory rehabilitation is far better compared to the tele rehabilitation services especially for those visiting tertiary care hospitals as most of them belong to lower and middle socioeconomic status. From the results, it can be delineated that with lesser hearing experience, paediatric CI users always need to initially enroll for conventional therapy for better speech-language and auditory outcomes.

Keywords:

Cochlear Implant; Tele-therapy; Conventional Therapy; Language Outcomes; Speech & Language Rehabilitation

1. Introduction:

We are living in the era of technology and can see the impact of science and technology everywhere around us. With the advancement in the science & technology the health system also evolved, and tele-practice is one of them. Literature review (Piron et al., 2008; Hughes et al., 2012; Malandraki, 2014; Blosser, 2015; Bush et al., 2016) provides the evidence stating the benefits of tele-practice in the area of speech-language pathology and audiology but very limited study are available in the Indian scenario (Goswami et al., 2012; Ramkumar et al., 2018; Ramkumar et al., 2019). Mohan et al., (2017), and Rao & Yashaswini (2018) highlighted the various challenges in implementing the tele-practice in India such as limited trained professionals in telepractice, unavailability of valid digital resources, privacy issues, unstructured regulations/policies/code of ethics for teleservices, and limited evidence based studies on teleservice delivery.

Following the coronavirus disease 2019 (COVID 19) pandemic, which blew out the whole world, professionals in almost every other discipline reverted to telepractice. In March 2020, the Ministry of Health and Family Welfare (MoHFW) published the revised guidelines for telemedicine service delivery whereas, in October 2020, the Indian Speech-Language and Hearing Association (ISHA) published the guidelines for teleservice in the speech-language pathology and audiology due to COVID-19 pandemic. After COVID-19 outbreak, various studies (Fritz et al., 2021; Chaudhary et al., 2021; Tambyraja et al., 2021; Volter et al., 2021) got published on delivery of teleservices for diverse populations with speech-language disorders and sudden increase in the use of tele-therapy modality was observed in the field of speech-language pathology & audiology services in India (Aggarwal et al., 2020). Chaudhary et al., (2021) compared the outcomes of tele-therapy and conventional face-to-face therapy for various speech-language disorders (i.e. fluency, voice, swallowing, and neurogenic disorders). The results revealed that teleservice was effective and satisfactory method for service delivery among speech-language disorders. Volter et al., (2021) assessed the feasibility of tele-therapeutic auditory rehabilitation among adult CI users and revealed that tele-therapy has good outcomes for speech perception. Many authors (Al Awaji et al., 2021; Chadd et al., 2021; Saxena et al., 2021) investigated the parental perception and clinician perception regarding the efficacy of tele-therapy. Results of these studies advocated the use of tele-therapy on regular basis and stated the tele-services as a reliable method of service delivery. However, Chadd et al., (2021) pointed that adult patients such as dysphagia had more positive attitude towards tele-therapy compared to pediatric population. Similarly, Saxena et al, (2021) also reported that parents of children with cochlear Implants (CI) preferred conventional face-to-face therapy compared to tele-therapy.

From the literature we can delineate that majority of the studies related to teleservices in the speech-language pathology & audiology are carried out on adult population, and very limited studies reported the caretaker's perception of those with Speech-language disorders, towards tele-therapy. This warrants the need to investigate the outcome measures of tele-therapy in CI children during the current adverse condition of COVID 19 pandemic. The targeted population here is the pre-lingual hearing impaired children fitted with CI for the present study who are

deprived of auditory experience thereby leading to the delayed speech & language development. Following CI, this population needs an extensive speech & language stimulation through aural rehabilitation for the developing various auditory skills and speech-language development. With the pandemic, majority of paediatric cochlear implantees lost the follow ups at the outdoor patient department (OPD) in tertiary care setup and hence tele therapy modality was initiated to render aural rehabilitative services in order to provide timely and adequate speech-language and auditory rehabilitation. .

2. Aim of the study:

The aim of the present study is to investigate the outcome measures of paediatric CI users on tele-therapy modality versus conventional face to face therapy following COVID-19 pandemic.

3. Method:

3.1 Participants:

A total of 27 unilateral paediatric cochlear implants in the age range 2-11 years participated as subjects for the study. The participants were divided into two groups based on the mode of rehabilitative service received, viz, tele-therapy and conventional face-to-face therapy. A total of 14 participants with mean hearing age of 8.37 ± 1.81 were included in the tele-therapy group, whereas 13 participants with mean hearing age of 5.69 ± 2.55 were enrolled for the conventional therapy. All the participants had the previous experience of conventional therapy services. The participants with any other additional conditions or associated deficits were excluded from the present study. The groups were further divided based on the hearing age of the participants as shown in Table 1.

Hearing Age Range (Years)	Mean Age \pm SD		No of Participants	
	Tele-therapy (Group I)	Conventional (Group II)	Tele-therapy (Group I)	Conventional (Group II)
0-2	1.23 ± 0.26	1.47 ± 0.33	3	7
2-4	2.74 ± 0.75	3.00 ± 0.40	4	3
≥ 4	5.25 ± 1.15	5.06 ± 0.66	7	3

Table 1: Demographic details of participants in tele therapy (group I) and conventional therapy (group II) groups with respect to hearing age of the subjects

3.2 Material Used:

For delivering the tele- rehabilitation, we used the WhatsApp video calling platform as majority of our population were from the lower socioeconomic with poor educational background. Also there were many technical challenges faced by the caretakers on other app based interaction. The participants were familiar with the WhatsApp platform as they used it on daily basis. WhatsApp is an America-based social networking platform. It has features like voice messages, text messages, video calls, voice calls, images and videos sharing, and amount transfer. It runs using the internet on mobile devices or desktops. Due to its user-friendly features and free availability, it is a top-rated social networking application in India.

To assess the status of speech, language and audition a complete speech & language test battery was administered. The test battery included the Integrated Scale of Development (ISD) (Cochlear Ltd., 2010), Speech Intelligibility Rating (SIR) scale (Allen et al., 2001), and Revised Categorical Auditory Perception (CAP-R) scale (Archbold et al., 1995). ISD assesses six parameters, viz, receptive language (RLA), expressive language (ELA), speech, audition, cognition, and pragmatics. The SIR is a five point rating scale developed for hard of hearing population whereas, the CAP-R consists of 12 performance categories for the auditory perception as depicted in Table 2.

Tests	Overview
Integrated Scale of Development (ISD)	ISD assesses language skills in six domains: receptive language, expressive language, speech, audition, cognition, and pragmatics. ISD can be used from 0 to 48 months of age children.
Speech Intelligibility Rating Scale (SIR)	SIR is a 5 point rating scale developed for hard of hearing population. Here, 1 indicates speech is unintelligible, and 5 shows connected speech is intelligible to all listeners.
Revised Category Auditory Perception (CAP-R)	CAP-R consists of 12 performance categories for the auditory perception where level 0 indicates “unaware of environmental sounds,” and level 12 suggest “CI recipient uses the telephone with unfamiliar speakers.”

Table 2: Description of test battery used to assess the speech & language skills

3.3 Procedure:

Prior to conducting the research informed consent was taken from the participants. All the participants underwent the complete audiological test battery and diagnosed with severe to profound hearing loss with no middle ear pathology. Before initiating the tele-rehabilitation services the baseline assessment was conducted using complete speech and language test battery, which included the above tools. Tele-therapy was provided to the participants with the frequency of one session per week and duration of the session was approximately 45-60 minutes. Before initiating the tele-therapy, regular call or text message was given to parents for arranging the materials for the session during tele-therapy modality. The assessment was performed at regular intervals of every three months and final assessment was performed after 12 months of tele-therapy to track the therapy progress for each of the domains from the baseline. The same procedure was followed for conventional therapy as well.

3.4 Statistical Analysis:

The statistical analysis was performed using SPSS version 20.0 software. The descriptive statistics was executed. To assess the difference between the pre-therapy and post-therapy performance within the groups, Wilcoxon Signed Rank test was performed owing to the small sample size. To execute the statistical analysis, the age groups given as ranges in ISD was converted into levels such as “level 1, 2 and so on” in which, Level 1 represents the age range of “0-3 months” and “level 11” representing the last age group of ISD (i.e. 43-48 months). The rate of progress was measured as the difference between the scores obtained in pre & post-therapy data points which ranged from 1st to 12th month of rehabilitation. The difference between the rate of progress between the groups were computed using Mann Whitney U Test.

4. Results:

A total of 27 participants with mean age and hearing age of 7.08 ± 2.51 and 2.79 ± 1.90 respectively participated in the present study. Among 27 participants, fourteen were males and thirteen were females. The participants were divided into two groups based on the mode of service delivery during aural rehabilitation, viz, tele therapy and conventional mode of therapy. Among 27, 14 were enrolled into the tele-therapy program and 13 were included in the conventional therapy program, the demographic detail of both the group is depicted in table 3.

Groups	Gender		Age Range (Years)	Mean Age \pm SD	Mean Hearing Age \pm SD
	Male	Female			
I (Tele-therapy)	10	04	5-11	8.37 ± 1.81	3.66 ± 1.9
II (Conventional Therapy)	03	10	2-11	5.69 ± 2.55	1.85 ± 1.74

Table 3: Demonstrating the demographic details of both the groups

4.1 Rate of progress after one year of therapy within the two groups:

After one year of therapy significant progress was observed in both the groups across all the domains of language, speech, and audition assessed with different assessment tools, as demonstrated in Figures 1, 2, 3 & 4. The Wilcoxon Signed Rank test was performed and significant differences between the pre & post therapy obtained as depicted in Table 4 except for the cognition parameter in the group I ($p > 0.05$).

Parameters of Different Test Used		Tele-therapy (Group I)			Conventional Therapy (Group II)		
		Pre-Therapy	Post-Therapy	P- value	Pre-Therapy	Post-Therapy	P- value
1 (ISD)	RLA	7.21 ± 1.67	8.64 ± 1.78	0.001*	4.23 ± 3.41	6.92 ± 2.81	0.001*
	ELA	7.00 ± 1.18	8.07 ± 1.63	0.000*	4.00 ± 3.16	6.84 ± 2.70	0.001*

	Speech	6.92±1.89	8.07±1.77	0.001*	4.08±3.14	6.46±2.22	0.002*
	Audition	7.78±1.52	8.92±1.43	0.000*	4.23±3.21	7.38±2.59	0.001*
	Cognition	10.57±1.34	10.78±0.80	0.180	7.92±1.93	10.23±1.30	0.002*
	Pragmatics	8.57±2.24	9.07±2.30	0.008*	6.23±3.05	8.38±2.10	0.001*
2	CAP	6.85±2.07	8.42±2.34	0.001*	3.07±3.22	6.15±2.23	0.001*
3	SIR	2.35±0.63	3.00±0.87	0.003*	0.92±1.02	2.23±1.12	0.001*

Table 4: Differences between pre & post therapy scores across various domains in ISD, CAP and SIR

(*Significant difference at the level of 95% i.e. $p < 0.05$)

From table 4, it is evident that there was significant difference obtained for group I on all the domains except cognition on comparison between the pre and post- teletherapy scores. Similarly, on comparison of the baseline scores to the scores of after 12 months of conventional therapy there was a significant difference obtained for group II on all the domains of ISD, CAP & SIR. The same has been depicted in the following figures.

The figures 1 & 2 depict the rate of progress between pre & post tele-therapy for group I with respect to domains in ISD, CAP, and SIR. The figures 3 & 4 demonstrate the rate of progress between pre & post conventional-therapy for group II with respect to domains in ISD, CAP, and SIR.

“Insert Fig 1 here”

Figure 1: Rate of progress between Pre-therapy v/s Post-therapy for the Tele-therapy Group across the domains in ISD

“Insert Fig 2 here”

Figure 2: Rate of progress between Pre-therapy v/s Post-therapy for the Tele-therapy Group on CAP & SIR

From figures 1 & 2, it can be delineated that the performance of the participants has improved with teletherapy as scores on all the domains of ISD, CAP, and SIR increased following the 12 months teletherapy. The same holds good for the rate of progress evidenced in conventional face to face therapy, where in post therapy scores were higher in comparison to the pre therapy scores for group II on all the domains of ISD, CAP & SIR as shown in Figures 3 & 4.

“Insert Fig 3 here”

Figure 3: Rate of progress between Pre-therapy v/s Post-therapy for the Conventional Therapy Group across the domains in ISD

“Insert Fig 4 here”

Figure 4: Rate of progress between Pre-therapy v/s Post-therapy for the Conventional Therapy Group on CAP & SIR

4.2 Comparison between the performances of the two groups of participants on the basis of hearing age:

On comparing the performances of two groups of participants with respect to hearing age, it was found that there was a significant difference between the rates of progress shown by the participants on all the parameters in the group with hearing age of 0-2 years as tabulated in table 5.

Parameters of Different Test Assessed		0-2 years			2-4 years			≥4 years		
		Grp I (Mean Rank)	Grp II (Mean Rank)	P value	Grp I (Mean Rank)	Grp II (Mean Rank)	P value	Grp I (Mean Rank)	Grp II (Mean Rank)	P value
1 (ISD)	RLA	2.67	6.71	.04*	3.00	5.33	0.11	4.93	6.83	0.31
	ELA	3.17	6.50	.04*	2.50	6.00	0.01*	4.43	8.00	0.03*
	Speech	3.00	6.57	.04*	2.88	5.50	0.07	5.14	6.33	0.41
	Audition	2.33	6.87	.02*	2.50	6.00	0.01*	4.00	9.00	0.003*
	Cognition	2.17	6.93	.01*	2.50	6.00	0.01*	4.64	7.50	0.09
	Pragmatics	2.17	6.93	.02*	3.25	5.00	0.18	4.57	7.63	0.09
2	CAP	2.17	6.93	.02*	3.63	4.50	0.55	5.07	6.50	0.45
3	SIR	2.67	6.71	.03*	3.63	4.50	0.38	4.71	7.33	0.12

Table 5: Difference in rate of progress made by the participants between the two groups

From table 5, it is evident that there is a significant difference between the participants rate of progress on all the parameters of ISD, CAP & SIR in the group with hearing age range of 0-2 years. In the group with hearing age range of 2-4 years, significant difference were seen between the participants' rate of progress for the three domains of ISD viz, ELA, audition, and cognition. Although, there was a difference observed between the other domains of ISD, CAP, and SIR, it was not statistically significant. Similar results were seen for the group with hearing age of 4 years and above. In this group with hearing age of 4 year and above, significant difference was found only for two domains of ISD viz, ELA & audition. However, there was differences observed scored obtained for other domains of ISD, CAP and SIR. From table 5, it can be delineated that the group which received the conventional therapy had high rate of progress in comparison to the group which received the tele-rehabilitation. These results are depicted graphically in the figures 5, 6, 7, 8, 9 & 10.

“Insert Fig 5 here”

Figure 5: Rate of progress of 0-2 year hearing age group between Tele-therapy v/s Conventional Therapy across the domains in ISD

“Insert Fig 6 here”

Figure 6: *Rate of progress of 0-2 year hearing age group between Tele-therapy v/s Conventional Therapy on CAP & ISD*

From figures 5 & 6, it can be observed that rate of progress of 0-2 hearing age group was much higher for the participants which received conventional therapy than the participants which received teletherapy in all the domains of the ISD, CAP & SIR .

“Insert Fig 7 here”

Figure 7: *Rate of progress of 2-4 year hearing age group between Tele-therapy v/s Conventional Therapy across the domains in ISD*

“Insert Fig 8 here”

Figure 8: *Rate of progress of 2-4 year hearing age group between Tele-therapy v/s Conventional Therapy on CAP & ISD*

From the figures 7 & 8, it can be concluded that the group with hearing age range of 2-4 years performed better with 12 months of conventional face to face therapy compared to the children enrolled for tele-therapy modality. Same was also observed for children with hearing age of 4 years and above as depicted in figure 9. The children with one year of conventional therapy had better scores on all domains of the ISD, CAP & SIR in comparison to the children who were on teletherapy as shown in figures 9 & 10.

“Insert Fig 9 here”

Figure 9: *Rate of progress of ≥ 4 year hearing age group between Tele-therapy v/s Conventional Therapy across the domains in ISD*

“Insert Fig 10 here”

Figure 10: *Rate of progress of ≥ 4 year hearing age group between Tele-therapy v/s Conventional Therapy on CAP & ISD*

5. Discussion:

The present study aimed to investigate the outcome measures of one year data of tele-rehabilitation and conventional face-to-face rehabilitation for paediatric cochlear implantees during the COVID-19 pandemic. Results of present study revealed that both the service delivery modalities were successful; however; conventional therapy mode had more impact on speech, language, and auditory skills. Results of the present study is in contrary to the findings of studies conducted by Piron et al., (2008), Hughes et al., (2012), Malandraki et al., (2014), Blosser (2015), Bush et al., (2016), Volter et al., (2021), and Choudhary et al., (2021). The differences between the findings of the present study and the other studies in the past could be attributed to the age differences of the participants considered. All the studies included the adults as their target population whereas; the present study was conducted on the pediatric group. Results of present study could be correlated with the study conducted by the Saxena et al, (2021) on the

parents of CI children. They reported that parents of CI children preferred conventional method of therapy compared to tele-therapy modality, as tele-rehabilitation with pediatric population is difficult and a challenging task for parents as well as the clinicians. Further, various limitations and challenges are reported with tele-therapy mode, such as connectivity issues, poor sound quality, and poor visibility. Same challenges were also discussed by Mohan et al., (2017), and Rao & Yashaswini (2018). Findings by the Chadd & colleagues (2021) support the results of our study. They assessed the impact of COVID-19 on the Speech-Language Pathologists and their patients and reported that tele-therapy for pediatric population is a challenging task.

The current study assessed the rate of progress after one year of rehabilitation with respect to hearing-age for both the service delivery rehabilitation modalities. Results revealed a significant difference for the hearing-age group of 0-2 years across all the parameters of speech, audition, and language skills. The mean rank of group II is higher than the group I which indicates that group who were on conventional therapy showed better performance. The significant difference was obtained only for some parameters for the hearing age group of 2-4 years and ≥ 4 years. Although difference between the mean ranks was observed they did not present with statistically significant difference. These findings could be explained with respect to their hearing age. The children with lesser hearing age needed intensive speech-language and auditory rehabilitation. Their guardians had less experience with the cochlear implants and needed more training to provide speech-language and auditory rehabilitation at home using diverse activities as per the clinicians' guidance. This explanation can be supported by the study conducted by Saxena and his colleagues (2021). They reported that parents who attended one year of conventional therapy had more positive attitude towards attending tele therapy services. However, parents whose child was fitted with CI recently during or just before the pandemic preferred conventional mode of therapy.

In the present study, lesser number of participants is one of the limitations. With lesser number of participants, it is difficult to generalize the results of the study to the rest of the population. However, with the current findings it is very evident that parents visiting a tertiary care setup belonging to the lower and middle socio economic status have lots of challenging factors right from owning a smart phone to a good data network package and managing their daily wages private jobs was not a cake walk for parents pursuing the tele-rehabilitation modality. .

6. Conclusion:

From the present study, we can conclude that conventional method of the speech-language and auditory rehabilitation is much better compared to the tele rehabilitation services. Results further indicate that with lesser hearing experience, paediatric CI users always need to initially enroll for conventional therapy for better outcomes. However, later on teleservices can be opted, once parents or caretakers get trained and children become familiar & comfortable with the implant use. The present study is a preliminary attempt to assess and understand the outcome measures on tele rehabilitation services which was a forced option to be opted for by the parents due to COVID 19 pandemic. Future studies demand extensive workup on similar lines for better understanding of efficacy of tele-therapy modality. These extensive studies will also help in

developing the evidence based tele-therapy rehabilitation program for CI children in Indian scenario.

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